

Nanomaterials and Applications in Chemical Engineering

CENG 4540

3 credits

Lecture: Mon 1:30 PM – 2:50 PM and Fri 9:00 AM – 10:20 AM at Rm 4579, Lift 27-28

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Teaching Assistants: TBA

Course Description

This course handles the basics of nanomaterials and nanotechnology and how chemical engineers can understand nanomaterials and use them for daily product applications. Chemical engineers play a vital role in the development of nanomaterials having unique properties originating from their nanoscale confinement. Those nanomaterials are becoming core technology in daily products in the field of chemical engineering, enabling much-enhanced performance. For example, nano-enabled lighter but durable bikes and airplanes, vibrant and accurate colors in displays, cheaper and faster catalysts, precise and fast-responding sensors, tailor-made surface coatings, and better adsorption for purification, etc. This course provides what students need to understand the fundamentals and applications of nanomaterials. We will put a higher importance on the science of nano, such as chemistry for synthesis and physics for the mechanism, because with a solid understanding of science, we can always become better engineers.

Required Texts and Materials

Lecture notes and readings will be posted on Canvas.

No official textbooks. Books students can refer to:

Introduction to Nanoscience and Nanotechnology. Chris Binns. 24 May 2010. Print ISBN:9780471776475, Online ISBN:9780470618837. DOI:10.1002/9780470618837. Copyright © 2010 John Wiley & Sons, Inc. PDF available through HKUST Library: <https://onlinelibrary.wiley.com/doi/book/10.1002/9780470618837>

Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Second Edition. Prof. Edward L. Wolf. 7 August 2006. Print ISBN:9783527406517. Online ISBN:9783527618972. DOI:10.1002/9783527618972. Copyright © 2006 WILEY-VCH Verlag GmbH & Co. KGaA. PDF available through HKUST Library: <https://onlinelibrary.wiley.com/doi/book/10.1002/9783527618972>

Expected Learning Outcomes

After this course, students should be able to

- apply principles of chemistry and physics to the novel nanotechnology and nanomaterials.
- understand the working principles of nanotools such as electron microscopy and probe microscopy etc.

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- analyze our daily products that are using nanomaterials
- appreciate the role of nanotechnology for chemical engineers

Course Requirements and Policies

Lectures: The lectures will be interactive, with questions, quizzes, watching videos, etc. Each class can start with a couple of quizzes, to remind essential concepts from the last class. Students are encouraged to participate in the classes through questions and discussions. Please be reminded that spending time on electronic devices, including mobile phones or other stuff, which can disturb classmates, should be avoided. In general, please take the rules seriously and follow them as a basic courtesy to the instructor and fellow students. We will not allow anyone to disrupt the learning of other students.

Quizzes: Classes will start with some quizzes through Canvas. You will be required to mark the answers and submit them to Canvas.

Project: Many of our daily products use nanotechnology/nanomaterials for improved performance. The project involves self-learning on how nanomaterials are used in those products. Students will be required to do a literature search to understand the underlying science that resulted in improved performance and compare it with other state-of-the-art technologies. Students will deliver their learning outcomes to the group by giving a presentation. Presentation is a crucial way of delivering ideas. Both the instructor and peer students will evaluate the presentation. The latter is called peer review. In the real world, after school days, your performance is evaluated by peers. In this regard, it is an excellent opportunity to experience the peer-review system professionally, a.k.a. a constructive and encouraging way. Communication through writing is an essential way to be successful in the real world as well. Only clear, logical, and persuasive writing will make an impact on the general and broad audience.

Exams: Students will take one final examination.

Academic Integrity: Students should follow academic integrity rules: <http://ugadmin.ust.hk/ug-guide/integrity/dishonesty.html>. Please pay special attention to the offense of plagiarism, which involves claiming credit for others' work as if it is your own, e.g., copying the homework of classmates, using the information on the internet without referencing the source. Serious offenders will be referred to the University for disciplinary action.

Assessments:

Parts		Points	Note
Quiz		35	Each quiz has equal weight for the total points. The lowest three scores will not be included in the points.
Project	Proposal	5	5 points: Submitted on time with a good plan. 4 points: Submitted on time, but it needs more work. 3 points: Hard to understand the intention of the proposal. Late submissions will be 50% off.
	Presentation	25	Evaluation: 20 points by YSK and 5 points by peers. *Individual project. Details will be updated later.
Final Exam		35	Closed book. One page (both sides) cheat sheet is allowed.

Assessment and Grading

This course will be assessed using criterion-referencing, and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Grading rubrics -- Literature Presentations

	Excellent (90-100%)	Satisfactory (70-90%)	Good (50-70%)	Points
1. Time	Finished on time (time TBA: e.g., 12–13 min)	+ or – 1 min	+ or – 2 min	
2. The work – your literature*	Demonstrated full knowledge of the subject topic. Described clearly and specifically the contents of the work. Also, offered adequate and interesting background information.	Offered enough background for the audience to understand the work, but failed to motivate the audience, lacking details and insights.	Speaker is uncomfortable with presentation, failed delivering key messages. Provided some but insufficient background for understanding.	
3. Delivery	Holds the entire audience's attention with the use of direct eye contact, seldom looking at notes. Proper pace. Confident, energetic, and engaging performance throughout.	Speaks with a good variation of volume and inflection but somewhat bland and lacking in enthusiasm. Largely maintained the attention of the audience.	Displays minimal eye contact with the audience while reading, mainly from the notes. Problematic pace, monotonous tone.	
4. Q&A – the way you handle questions.	Answered all questions in a professional way.	Answered questions but lacking insights.	Answered only basic questions in a superficial way.	

AI policy of the course

The use of Generative AI in projects is permitted with proper acknowledgment only for the projects. Students must clearly indicate which parts of their work were generated or assisted by AI tools and provide appropriate citations.

Tentative schedules

#	Date	Lecture topic	Note
1	Sep 4 (F)	Introduction	
2	Sep 7 (M)	Background	
3	Sep 11 (F)	Carbon nanomaterials	Quiz starts
4	Sep 14 (M)	Carbon nanomaterials	
5	Sep 18 (F)	Fabrication methods	
	Sep 21 (M)	Fabrication methods	
6	Sep 25 (F)	Characterizations	
7	Sep 28 (M)	Characterizations	
8	Oct 2 (F)	Surface, Energy, and Interactions	
	Oct 5 (M)	Surface, Energy, and Interactions	
	Oct 9 (F)	Surface, Energy, and Interactions	

9	Oct 12 (M)	Surface, Energy, and Interactions	
10	Oct 16 (F)	<u>Project Explanation</u>	
11	Oct 19 (M)	<i>Public holiday</i>	
12	Oct 23 (F)	Modification, and Supramolecular Chemistry	
13	Oct 26 (M)	Modification, and Supramolecular Chemistry	
	Oct 30 (F)	Nanoporous Materials and Applications	
14	Nov 2 (M)	Nanoporous Materials and Applications	Proposal due
15	Nov 6 (F)	Nanocomposites and Networks	
16	Nov 9 (M)	Nanocomposites and Networks	
17	Nov 13 (F)	Quantum Dots and Applications	
18	Nov 16 (M)	Quantum Dots and Applications	
19	Nov 20 (F)	<u>Presentations</u>	
20	Nov 23 (M)	<u>Presentations</u>	
21	Nov 27 (F)	<u>Presentations</u>	
22	Nov 30 (M)	<u>Presentations</u>	